

Introduction to Digital Photography Session 2 – Exposure

Scott Hull
5/7/2020

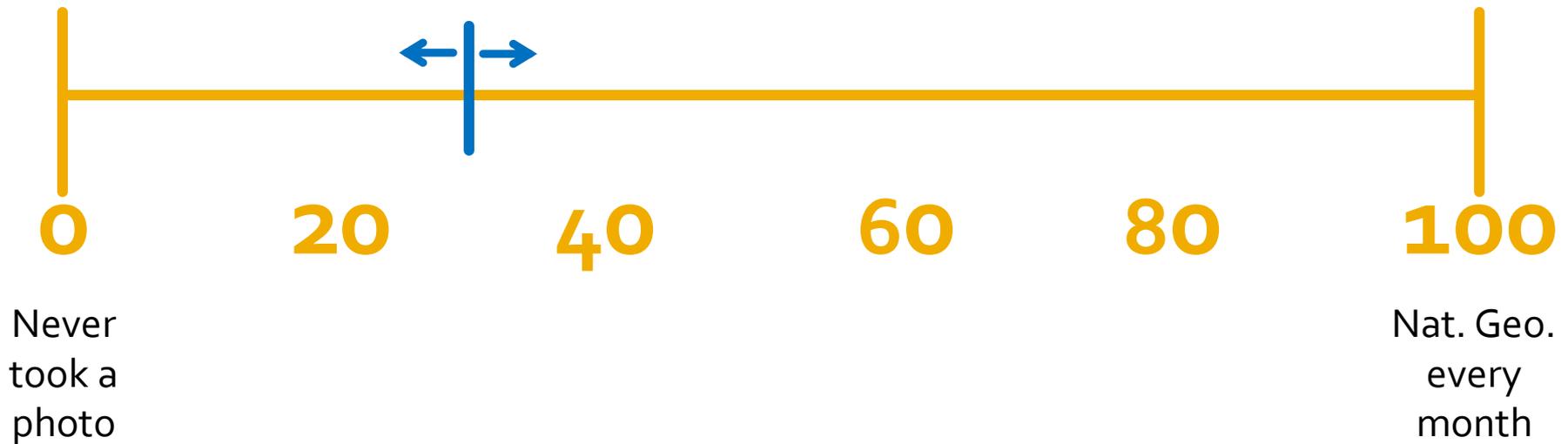
Learn the rules like a pro, so you can break them like an artist.
Pablo Picasso

Agenda

- Terms
- How a camera works
- Shutter speed
- Aperture
- Sensitivity
- Balancing the exposure
- White balance
- File saving choices
- Homework

Next week we'll talk about how to get your camera to do what you want it to do.

Where are you as a photographer?



- Everybody is somewhere between 1 and 99
- As skills develop, you will want more capable equipment
- Know where you are now, where you want to end up, and how to get there (usually practice)

Terms

- Composition
 - Your vision for what you want the image to look like
 - Balance of placement, orientation, focus, depth of field, intent, patterns ...
- Exposure
 - The way to achieve the effect you want
 - A balance of Shutter Speed, Aperture, and Sensitivity
- Depth of Field
 - Distance between the nearest and farthest objects in a scene that appear acceptably sharp in an image
- White Balance
 - The color correction for the light you are collecting
- Raw vs. JPEG
 - Different ways to save your image
 - Raw is just raw data – all of it
 - JPEG is processed and compressed

How a Digital Camera Works

1. You compose your shot
2. Either you or the camera focuses the image
3. You press the Shutter Release button
4. The shutter travels across in front of the sensor, letting light strike the sensor for a fixed length of time, then it is closed again
5. A computer inside the camera reads the signal out of the sensor, amplifies it, and saves it
6. The computer puts the signal together into an image and shows it to you

Exposure has three components

The specific settings are all about what you want in the final product, but they're usually a compromise

- **Shutter Speed** (1/xxx sec)
 - How long is the shutter open
- **Aperture** (f/# ratio)
 - How much light you are collecting
- **Sensitivity** (ISO)
 - How much light the sensor needs

Shutter Speed

- The amount of time that the shutter is open
 - Despite the name, it's actually a time, not a speed
- **Faster to freeze action, slower to blur**
- Also a factor of how long you can hold still
- Usually expressed as a fraction of a second
 - Please don't say "one over..."
- Typical values range from $1/60$ to $1/250$ sec
 - Can be much faster to freeze action
 - Can be much slower with a tripod

Waterfall at various shutter speeds



1/800

1/200

1/30

1/3

1

Shutter Speed in Seconds

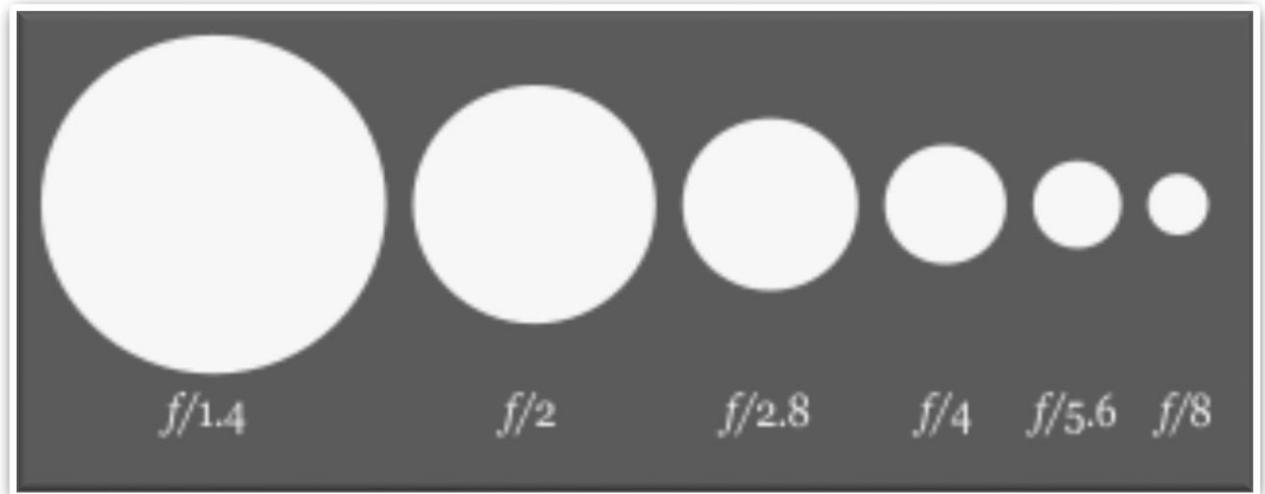
- Set camera to Shutter Priority Mode (usually "S" symbol) or manual ("M")
- For slow shutter speeds, go with higher f/# to let in less light (f/big number)
- For extreme cases, or sunny days, put an ND filter on your lens for less light
- For slow shutter speeds, use tripod or set on a rock
- Use a remote or self-timer to eliminate camera shake of pressing button

Aperture

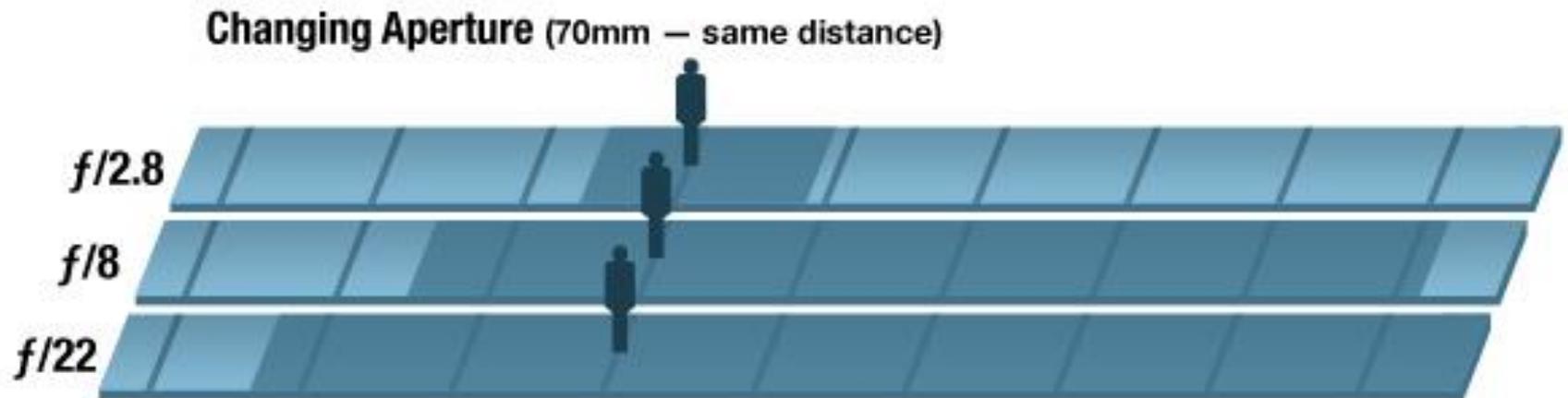
- Between the lens and the shutter is an iris that can be closed to use less of the lens
- The smaller this opening, the longer the depth of field
 - Larger aperture, blur foreground and background
 - Smaller aperture, sharper foreground and background
- Represents a fraction, but usually described as just the denominator: $f/4.5 = \text{"f } 4.5\text{"}$
- **The number is a relative indication of how much depth of field you will get**

What Is Aperture?

- Portion of the lens opening being used
- Expressed as a ratio of the focal length to the diameter (f-stop)
- Aperture numbers change by a factor of 1.4
 - Square root of 2, since double the light is 2x area
 - Area of a circle is πr^2 : $\sqrt{2} = 1.414$ is the change in diameter



Aperture vs. DOF



Source: Fredrik Silverglimth,
<http://www.tutorial9.net/tutorials/photography-tutorials/depth-of-field-in-photography/>

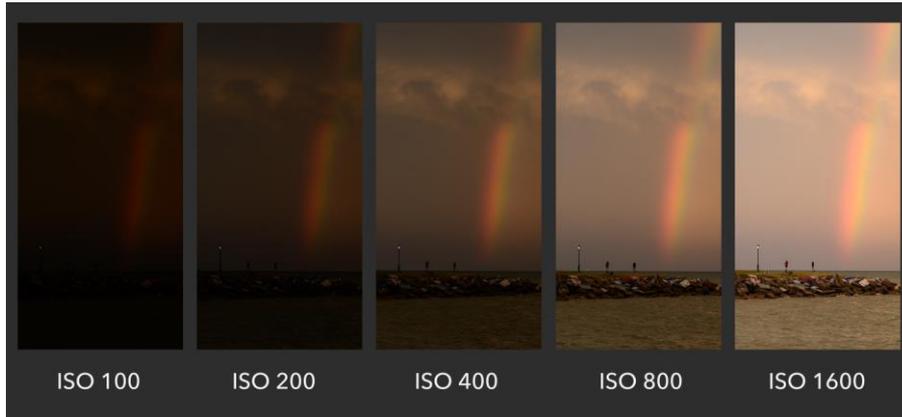
Sensitivity

- Relatively easy concept, but the technical details can get nerdy
 - *The higher the sensitivity setting, the less light you need, but the more noise you will get*
- A rating from the film days of the grain size of the film crystals
 - Coarser crystals gathered light faster, so were more sensitive
 - Finer crystals gathered light slower, but produced a less 'grainy' image
- In digital cameras, it tells the computer how high to 'crank' the amplifiers that read the signal from the sensor
 - Actually the gain setting...
- Digital camera sensitivity rating is roughly equivalent to film ratings, but by a different mechanism

Sensitivity continued

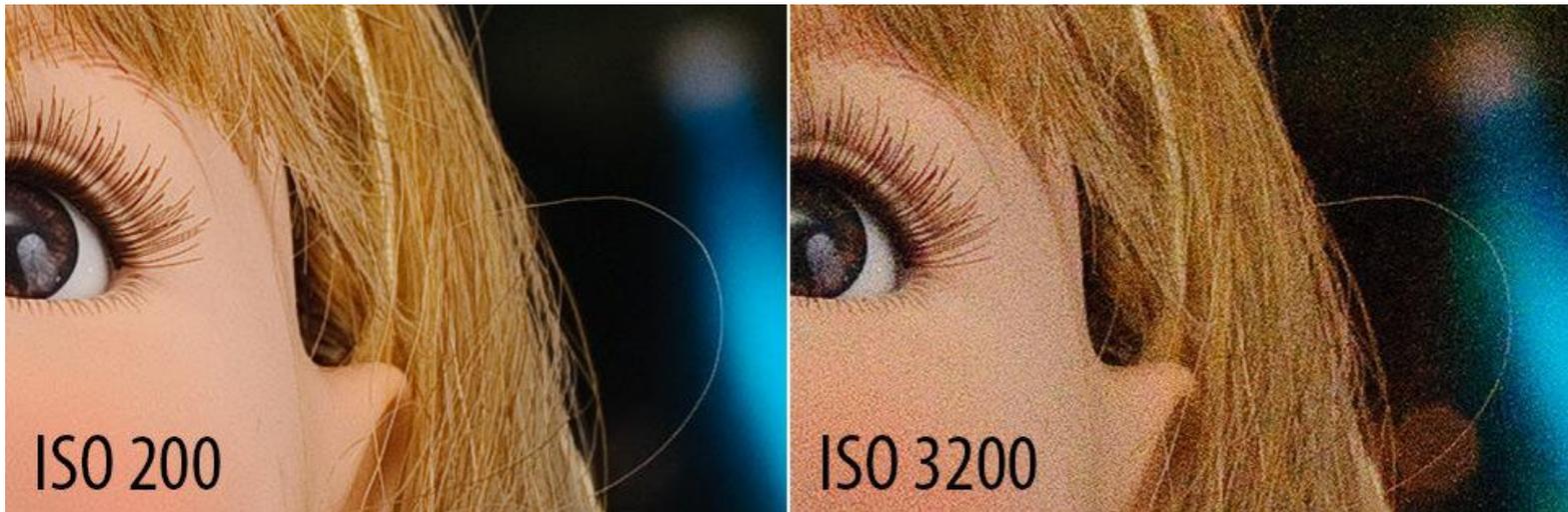
- How low can you go? Stay as low as you can, but get the shot!
- If you need more amplification, you will get more noise
 - It induces less noise to do this in the camera than later on the computer
 - But don't miss the shot because you were worried about noise
 - Noise reduction software is very good
- The biggest improvement in cameras has been to reduce the noise in those amplifiers; drops by about $\frac{1}{2}$ every couple years
- Typically expressed as "ISO XXX"
 - ISO is not actually an acronym, but the name of the International Organization for Standards, derived indirectly from Greek, and thus a word: *eye sew*
 - But please don't say "Increase the ISO"...

Sensitivity Examples



Same light, changing the sensitivity

Balanced image, different sensitivity



Stops

- A whole 'stop' is a change in the amount of light by half or double

$1/250 \text{ sec} \leftrightarrow 1/125 \text{ sec} \leftrightarrow 1/60 \text{ sec}$

$200 \text{ ISO} \leftrightarrow 400 \text{ ISO} \leftrightarrow 800 \text{ ISO}$

$f/4 \leftrightarrow f/2.8 \leftrightarrow f/2$

- Most cameras now also use partial stops
 - 1/3 stop is most common
 - Three 1/3 stops to double or halve the light

Exposure examples

Combo of **aperture**, **shutter speed** & **sensitivity**



1



■ aperture ■ shutter speed ■ ISO

f/8, 1/8 s,
ISO 500



2

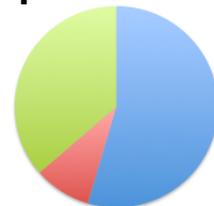


■ aperture ■ shutter speed ■ ISO

f/29, 1 s,
ISO 500



4

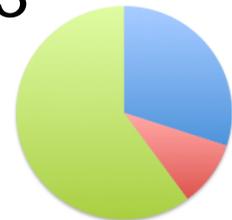


■ aperture ■ shutter speed ■ ISO

f/4.5, 1/20 s,
ISO 500



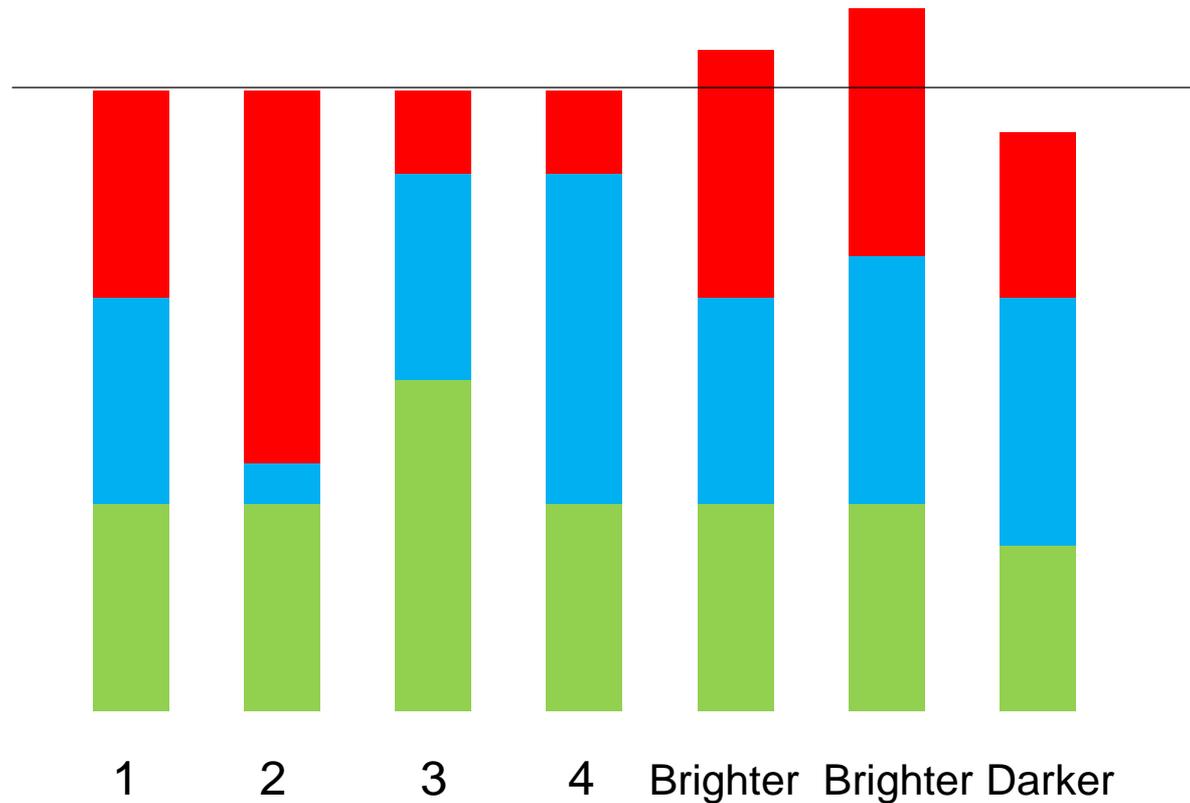
3



■ aperture ■ shutter speed ■ ISO

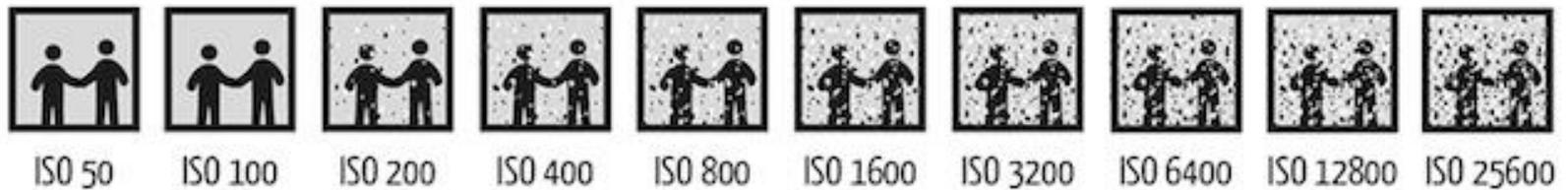
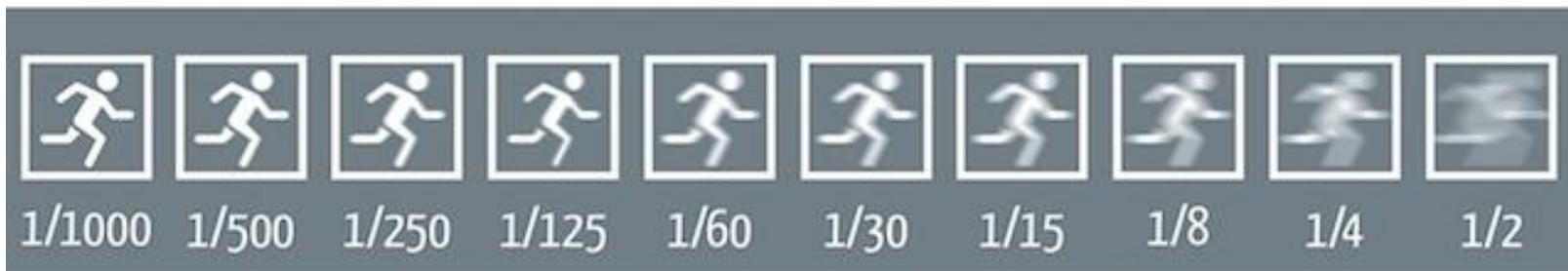
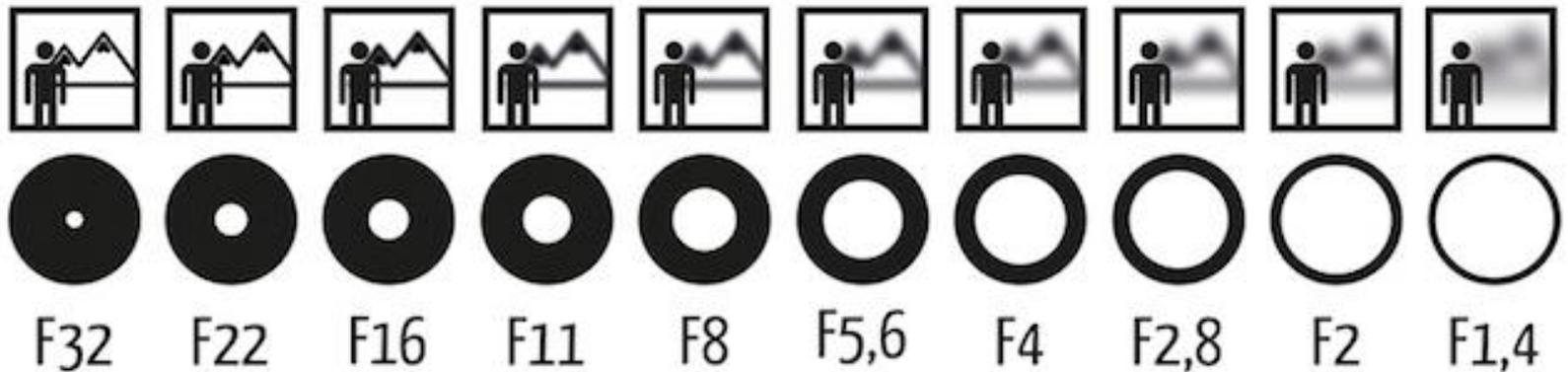
f/8, 1/20 s,
ISO 1600

Another way to look at exposure



Adding or subtracting stops of **SHUTTER SPEED**, **APERTURE**, or **SENSITIVITY** can be used to change the overall exposure, or to affect the appearance of an image (depth of field, motion, etc.). (Adding stops is actually multiplying the exposure).

Good Summary Chart



White Balance

- Colors change based on the type of light
 - Light brown shirt in incandescent light can look green in fluorescent light
 - Even sunlight vs. shade makes a difference
- Image is interpreted differently based on settings
- Auto white balance is pretty good ~98% of the time
- Check your display frequently, and change the WB if necessary
- RAW images are not corrected, so you can change it later if it was incorrect
- Most better cameras can also set WB manually for unusual situations

Files/ Image Quality

- Raw vs. JPEG
 - Raw is all of the data, straight from the sensor
 - Largest files, most flexibility later, and highest resolution
 - JPEG is **processed** and **compressed** before saving
 - You can't un-process or un-compress the image later
 - Compression losses occur each time it is saved
- Why not just maximize everything with raw?
 - Little discernible loss in image quality until you zoom in
 - Saving raw files takes longer
 - Memory cards are big, but not infinite capacity
 - You may be satisfied with JPEG image
 - No post-processing software or skills (shame on you!)
 - Raw images are also not as portable between viewers

Raw vs. JPEG

Olympus E-5; 12.3 MP camera
(MD Renaissance Festival, 2011)



Raw: 12.4 MB



JPEG: 5.3 MB

What's next?

Now that I

- Composed the shot in my head, and
- Figured out what exposure I want my camera to capture,

How do I tell *it* to do that?

Next week we'll go over:

- Camera settings
- Camera features
- "The best camera"
- THE most important button
- Lenses
- Accessories
- Gadgets
- What's next?

Recommended References

- Your camera User's Manual – read it!
 - Download it to your smart phone for easy searching
 - Carry it in your camera bag for reference
- Web sites
 - www.DPReview.com
 - www.photoextremist.com
 - <https://www.dpmag.com/>
- TV show Wild Photo Adventures
<http://www.wildphotoadventures.com/>
- Magazines
 - Outdoor Photographer
 - Lots of good British magazines

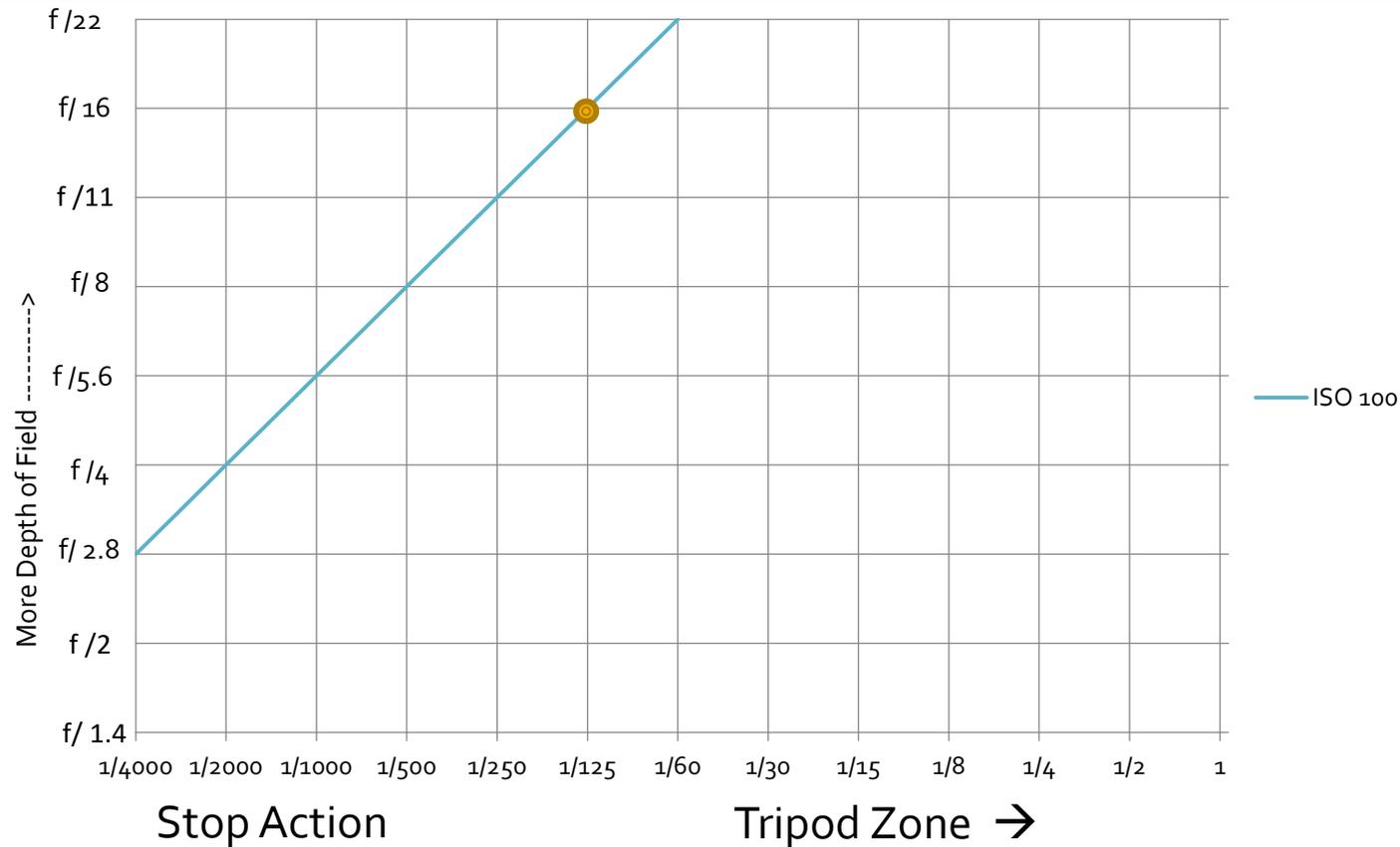
Exercises

- Aperture
 - Complete these sequences of apertures:
 - $f/2, f/2.8, f/4, f/5.6, f/8, f/11, f/16, f/22$
What do you notice about every other one?
 - $f/5.6, f/6.3, f/7.1, f/8, f/9, f/10, f/11, f/13, f/16$
You can use your camera to find the 1/3 stops
- You're shooting at $f/6.3, 1/400$ sec, 200 ISO, and you want 1 stop more depth of field. What settings would give you that with the same final exposure?
- You're shooting in the early evening at your widest aperture ($f/4$), 800 ISO, and $1/60$ sec. It's starting to get blurry images. What new settings might help?
- The shots you got last weekend at $f/16, 1/2000$ sec, and ISO 3200 were sharp but kind of grainy when you downloaded them. What settings might have been better?
- What file format do you think matches *your* current capabilities and needs best? (there is no answer that is right for everybody, and it might even be a combination)

Backup Slides

Exposure Review

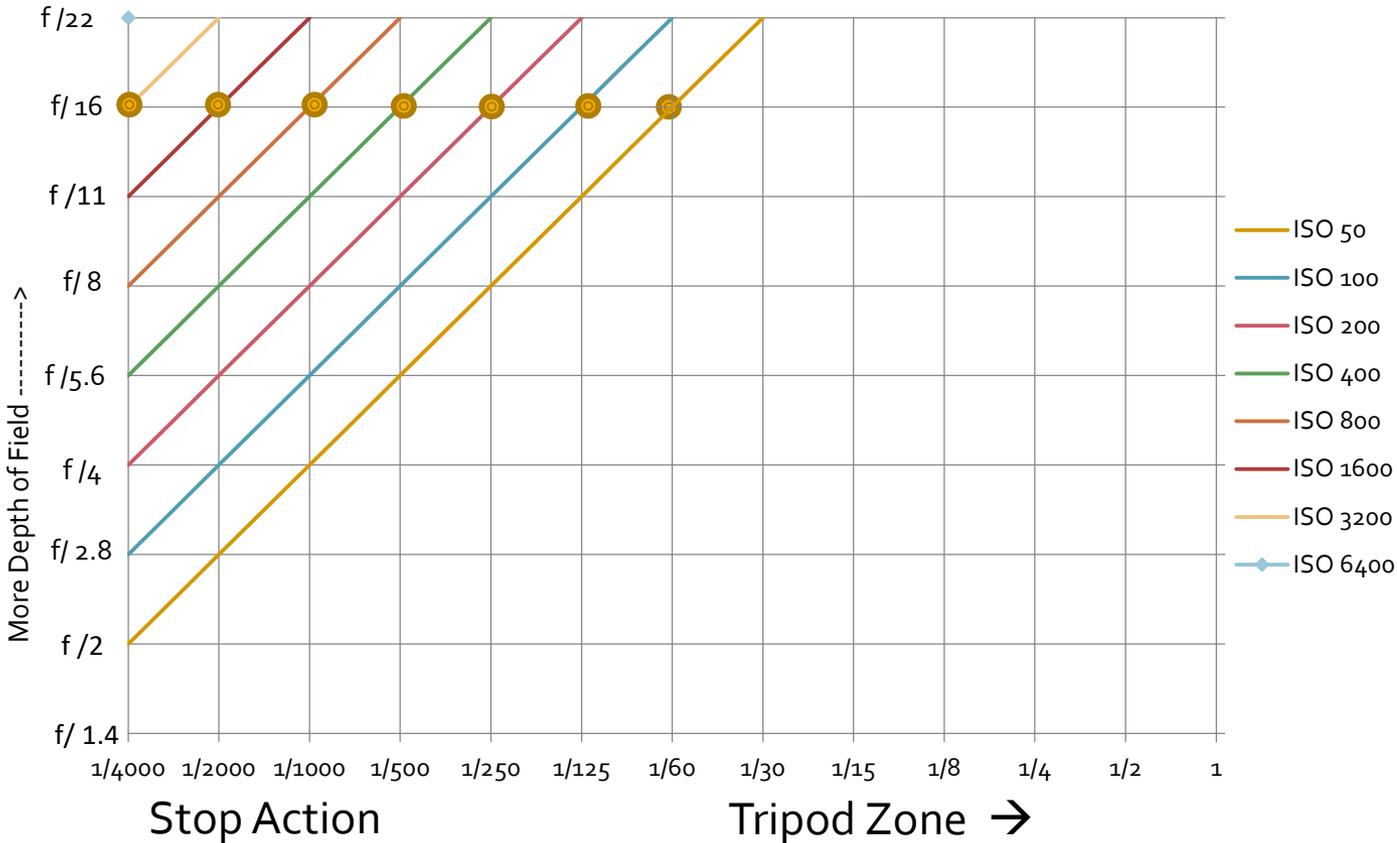
Sunny 16 Rule



On a sunny day, at f/16, the shutter speed is 1/ISO

Exposure Review

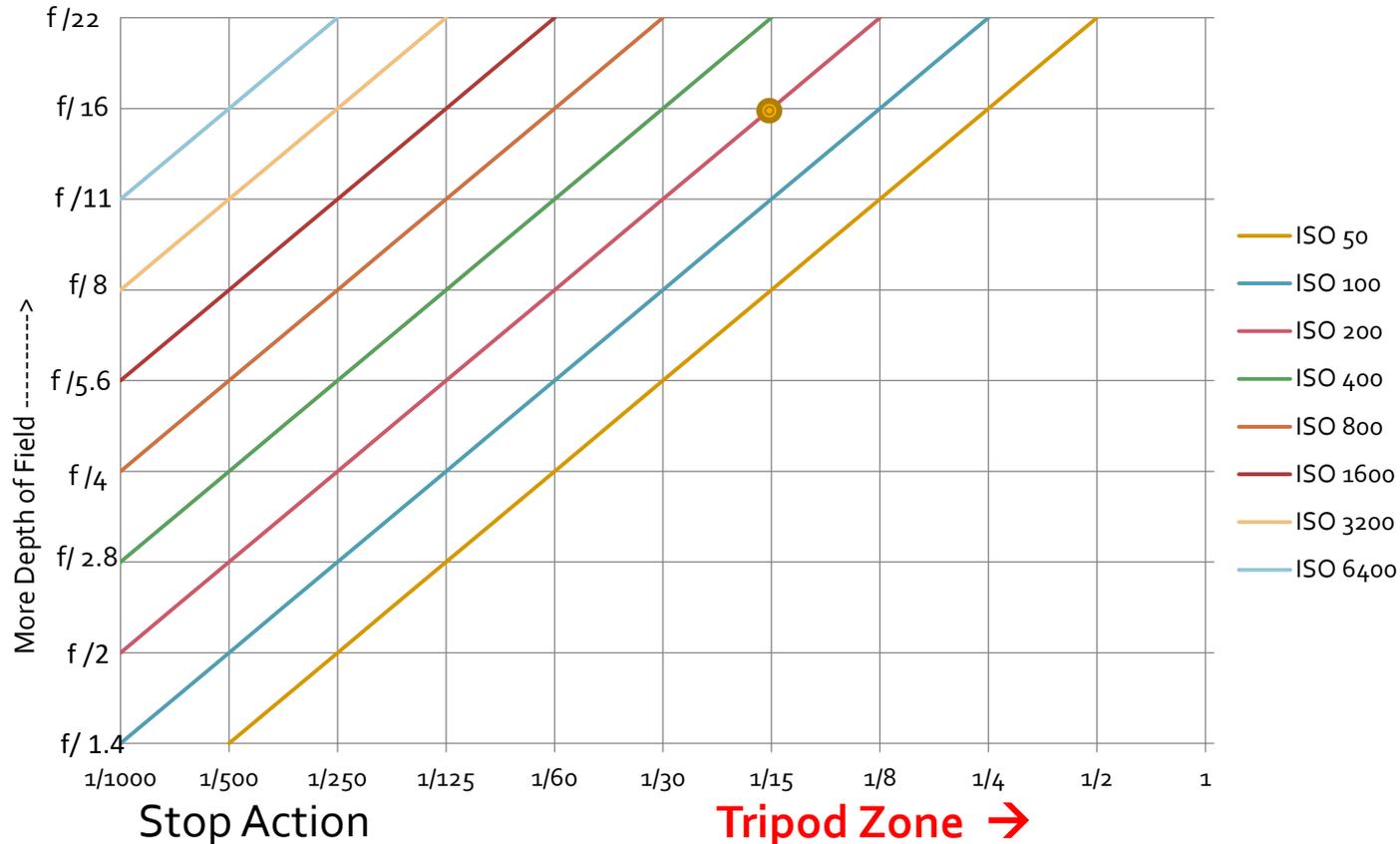
Sunny 16 Rule



On a sunny day, at f/16, the shutter speed is 1/ISO
These ISOs are one stop apart.

Exposure Review

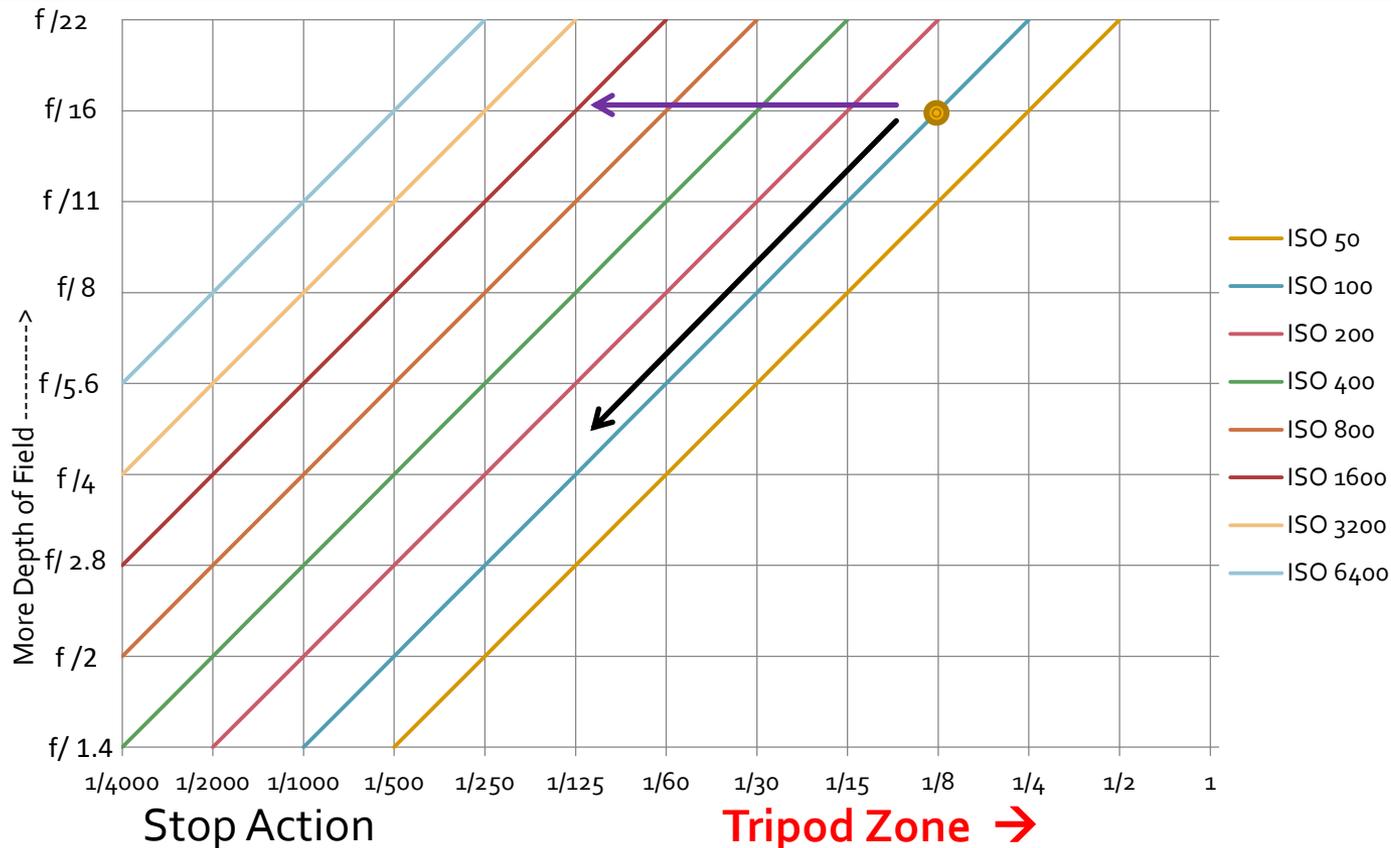
Sunny 16 Rule – in the shade (-2 stops)



At f/16, the shutter speed is $1/\text{ISO} + 2$ stops
 $1/100$ sec + 2 stops more light is $1/25$ sec

Exposure Review

Sunny 16 Rule – indoors (-4 stops)



At f/16, the shutter speed is $1/\text{ISO} + 4$ stops
 $1/100$ sec + 4 stops more light is $1/6$ sec